Project Proposal

Billing & Inventory Management System

Guided By

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Table Of Contents

Introduction

In the current era of digital transformation, small and medium-scale retail businesses face significant challenges in managing their day-to-day operations manually. Traditional paper-based bookkeeping is prone to calculation errors, lacks real-time inventory tracking, and makes it difficult to adapt to changing tax regulations (like GST updates).

To address these issues, we have developed the **Billing & Inventory System**. This is a command-line application developed using **Java**, **JDBC**, **MySQL**, and **Maven**. This is a robust, Java-based Console Application designed to automate the entire retail lifecycle.

It simulates a real-world scenario where it allows the **Administrator** to manage the supply chain (Brands, Categories, Taxes), while allowing **Customers** to browse products, add items to a cart, and generate professional invoices dynamically. Advanced features such as **dynamic tax calculation (GST)**, **low-stock alerts**, **payment mode selection**, and **sales history tracking** make the system realistic and feature-rich.

All functionalities operate through **Java's CLI (Command Line Interface)**, making the system lightweight, platform-independent, and easy to run in academic labs using **Eclipse IDE**.

Objective

The primary objective of this project is to build a fully functional console-based retail system that showcases real-world software engineering concepts such as **Data Normalization**, **Maven Build Management**, and **JDBC Transaction Handling**.

Specific objectives include:

1. To simulate real-world retail workflows The project recreates the complete cycle of store management:

- a. Configuring Master Data (Brands, Taxes, Categories).
- b. Adding products and updating stock.
- c. Customer cart management.
- d. Generating invoices with tax breakdown.

2. Functional Objectives:

- Automation: To eliminate manual calculations for billing, taxes, and discounts.
- Dynamic Configuration: To allow the shop owner to update Tax Rates (e.g., changing GST from 12% to 18%) or add new Payment Modes without rewriting the code.
- Inventory Control: To prevent "Out of Stock" scenarios by strictly tracking quantity updates in real-time.

3. Technical Objectives:

- Database Normalization: To implement a complex 9-table schema that minimizes data redundancy using Foreign Keys.
- Java Core Concepts: To practically apply **JDBC** (for database connectivity), **Collection Framework** (ArrayList for the shopping cart), and **Exception Handling**.
- Build Management: To utilize **Maven** for managing project dependencies (MySQL Connector) and directory structure.

4. To provide a strong academic example The project serves as a comprehensive demonstration of:

- a. Core Java (Collections, Exceptions).
- b. JDBC Prepared Statements.
- c. SQL Joins and Normalization.
- d. Team Collaboration (2-Member development).

Project Category

1. Application Type: Desktop Console Application (CLI) This project is developed as a **Command Line Interface (CLI)** application. Unlike Graphical User Interfaces (GUI) that rely on windows and buttons, this system interacts with the user through standard input/output streams (`System.in` and `System.out`).

2. Database Application Project: The system relies on a Normalized MySQL model with 9 interconnected tables.

3. Core Java Application: Built using Java 8+ principles, OOP, and Collection Framework.

4. JDBC-Based CRUD System: Demonstrates professional JDBC usage including Connection Pooling and Transaction Management.

Analysis

Modules and Description :

The project is architected into 4 core functional modules:

Module 1: Product Management (Admin)

- **1.1 Product Creation:** Admin adds items to the `products` table, linking them to **Categories**, **Brands**, and **Tax Slabs** via Foreign Keys.
- **1.2 Product Update:** Modify details like Price, Tax Rate, or Brand associations.
- **1.3 Product List:** View the complete catalog sorted by Category or Brand.
- **1.4 Product Details:** Fetch specific details including Tax percentage and Category ID.
- **1.5 Product Deletion:** Remove obsolete items (with validation checks against active sales).

Module 2: Inventory Management (Admin)

- **2.1 Stock Status:** Check available quantity filtered by Brand or Category.
- **2.2 Stock Refill:** Update stock quantities when new shipments arrive.
- **2.3 Low Stock Alert:** Auto-highlight items below the defined threshold.
- **2.4 Stock Adjustment:** Auto-deduct stock immediately after a sale is committed.

Module 3: Cart & Customer Management (Customer)

- **3.1 Customer Entry:** Capture Name and Phone Number to link transactions to a "Customer History" record.
- **3.2 Browse Catalog:** View products with **Final Price** (Base Price + linked Tax Rate) calculated dynamically.
- **3.3 Cart Management:** Uses Java `ArrayList` to manage selected items temporarily.
- **3.4 Update/Remove:** Modify quantities or remove items before checkout.

Module 4: Billing & Sales Management (Sales)

- **4.1 Bill Calculation:** Logic to sum `(Price + Tax) * Quantity`. Payment Mode (Cash/UPI) is selected from the `payment_modes` table.
- **4.2 Invoice Generation:** Prints a detailed console receipt.
- **4.3 Sales Record:** Commits the Bill Header to `sales` and Bill Details to `sale_items`.
- **4.4 Sales History:** Admin views past revenue reports.

Database Design :

The database design follows relational schema principles and uses **9 Normalized Tables** with proper Foreign Keys to maintain data integrity.

1. **`users`**: Stores login credentials for Admin/Staff.

```
mysql> desc users;
+----------+-------------+------+-----+---------+----------------+
| Field    | Type        | Null | Key | Default | Extra          |
+----------+-------------+------+-----+---------+----------------+
| user_id  | int         | NO   | PRI | NULL    | auto_increment |
| username | varchar(50) | NO   | UNI | NULL    |                |
| password | varchar(50) | NO   |     | NULL    |                |
| role     | varchar(20) | NO   |     | NULL    |                |
+----------+-------------+------+-----+---------+----------------+
```

2. **`categories`**: Groups products logically.

```
mysql> desc categories;
+-------------+--------------+------+-----+---------+----------------+
| Field       | Type         | Null | Key | Default | Extra          |
+-------------+--------------+------+-----+---------+----------------+
| category_id | int          | NO   | PRI | NULL    | auto_increment |
| name        | varchar(50)  | NO   |     | NULL    |                |
| description | varchar(100) | YES  |     | NULL    |                |
+-------------+--------------+------+-----+---------+----------------+
```

3. **`brands`**: Manufacturer lookup.

```
mysql> desc brands;
+-----------+-------------+------+-----+---------+----------------+
| Field     | Type        | Null | Key | Default | Extra          |
+-----------+-------------+------+-----+---------+----------------+
| brand_id  | int         | NO   | PRI | NULL    | auto_increment |
| brand_name| varchar(50) | NO   |     | NULL    |                |
+-----------+-------------+------+-----+---------+----------------+
```

4. **`taxes`**: Dynamic Tax Configurations.

```
mysql> desc taxes;
+----------+-------------+------+-----+---------+----------------+
| Field    | Type        | Null | Key | Default | Extra          |
+----------+-------------+------+-----+---------+----------------+
| tax_id   | int         | NO   | PRI | NULL    | auto_increment |
| tax_name | varchar(20) | YES  |     | NULL    |                |
| rate     | double      | NO   |     | NULL    |                |
+----------+-------------+------+-----+---------+----------------+
```

5. **`payment_modes`**: Payment types (Cash, UPI).

```
mysql> desc payment_modes;
+-----------+-------------+------+-----+---------+----------------+
| Field     | Type        | Null | Key | Default | Extra          |
+-----------+-------------+------+-----+---------+----------------+
| mode_id   | int         | NO   | PRI | NULL    | auto_increment |
| mode_name | varchar(20) | YES  |     | NULL    |                |
+-----------+-------------+------+-----+---------+----------------+
```

6. **`products`**: Master Inventory (Links to above tables).

```
mysql> desc products;
+-------------+---------------+------+-----+---------+----------------+
| Field       | Type          | Null | Key | Default | Extra          |
+-------------+---------------+------+-----+---------+----------------+
| product_id  | int           | NO   | PRI | NULL    | auto_increment |
| name        | varchar(100)  | NO   |     | NULL    |                |
| price       | double        | NO   |     | NULL    |                |
| quantity    | int           | NO   |     | 0       |                |
| category_id | int           | NO   | MUL | NULL    |                |
| brand_id    | int           | NO   | MUL | NULL    |                |
| tax_id      | int           | NO   | MUL | NULL    |                |
+-------------+---------------+------+-----+---------+----------------+
```

7. **`customers`**: Customer loyalty data.

```
mysql> desc customers;
+-------------+---------------+------+-----+---------+----------------+
| Field       | Type          | Null | Key | Default | Extra          |
+-------------+---------------+------+-----+---------+----------------+
| customer id | int           | NO   | PRI | NULL    | auto increment |
| name        | varchar(100)  | YES  |     | NULL    |                |
| phone       | varchar(15)   | YES  | UNI | NULL    |                |
| email       | varchar(100)  | YES  |     | NULL    |                |
+-------------+---------------+------+-----+---------+----------------+
```

8. **`sales`**: Bill Header.

```
mysql> desc sales;
+--------------+--------------------+------+-----+--------------------+----------------+
| Field        | Type               | Null | Key | Default            | Extra          |
+--------------+--------------------+------+-----+--------------------+----------------+
| sale_id      | int                | NO   | PRI | NULL               | auto_increment |
| sale_date    | datetime           | YES  |     | current_timestamp() |                |
| total_amount | double             | YES  |     | NULL               |                |
| customer_id  | int                | NO   | MUL | NULL               |                |
| user_id      | int                | NO   | MUL | NULL               |                |
| mode_id      | int                | NO   | MUL | NULL               |                |
+--------------+--------------------+------+-----+--------------------+----------------+
```

9. **`sale_items`**: Bill Details.

```
mysql> desc sale_items;
+---------------+-------------+------+-----+---------+----------------+
| Field         | Type        | Null | Key | Default | Extra          |
+---------------+-------------+------+-----+---------+----------------+
| id            | int         | NO   | PRI | NULL    | auto_increment |
| sale_id       | int         | NO   | MUL | NULL    |                |
| product_id    | int         | NO   | MUL | NULL    |                |
| qty_sold      | int         | NO   |     | NULL    |                |
| price_at_sale | double      | YES  |     | NULL    |                |
+---------------+-------------+------+-----+---------+----------------+
```

ER Diagram :

Relationships - derived directly from your 9-Table Database Schema and Java implementation.

1 : Master Data Relationships (Product Setup)

These relationships define how a product is categorized and taxed.

- **Category —-> Product**
  - **Relationship:** One **Category** (e.g., Electronics) *contains* many **Products** (e.g., Mouse, Keyboard).
  - **Cardinality:** 1 : N (One-to-Many)
  - **Link:** products.category_id references categories.category_id.
- **Brand —-> Product**
  - **Relationship:** One **Brand** (e.g., Samsung) *manufactures* many **Products**.
  - **Cardinality:** 1 : N (One-to-Many)
  - **Link:** products.brand_id references brands.brand_id.
- **Tax —-> Product**
  - **Relationship:** One **Tax Slab** (e.g., GST 18%) *applies to* many **Products**.
  - **Cardinality:** 1 : N (One-to-Many)

    - **Link:** products.tax_id references taxes.tax_id.

2. Transaction Header Relationships (The Bill)

These relationships define "Who bought what, who sold it, and how they paid."

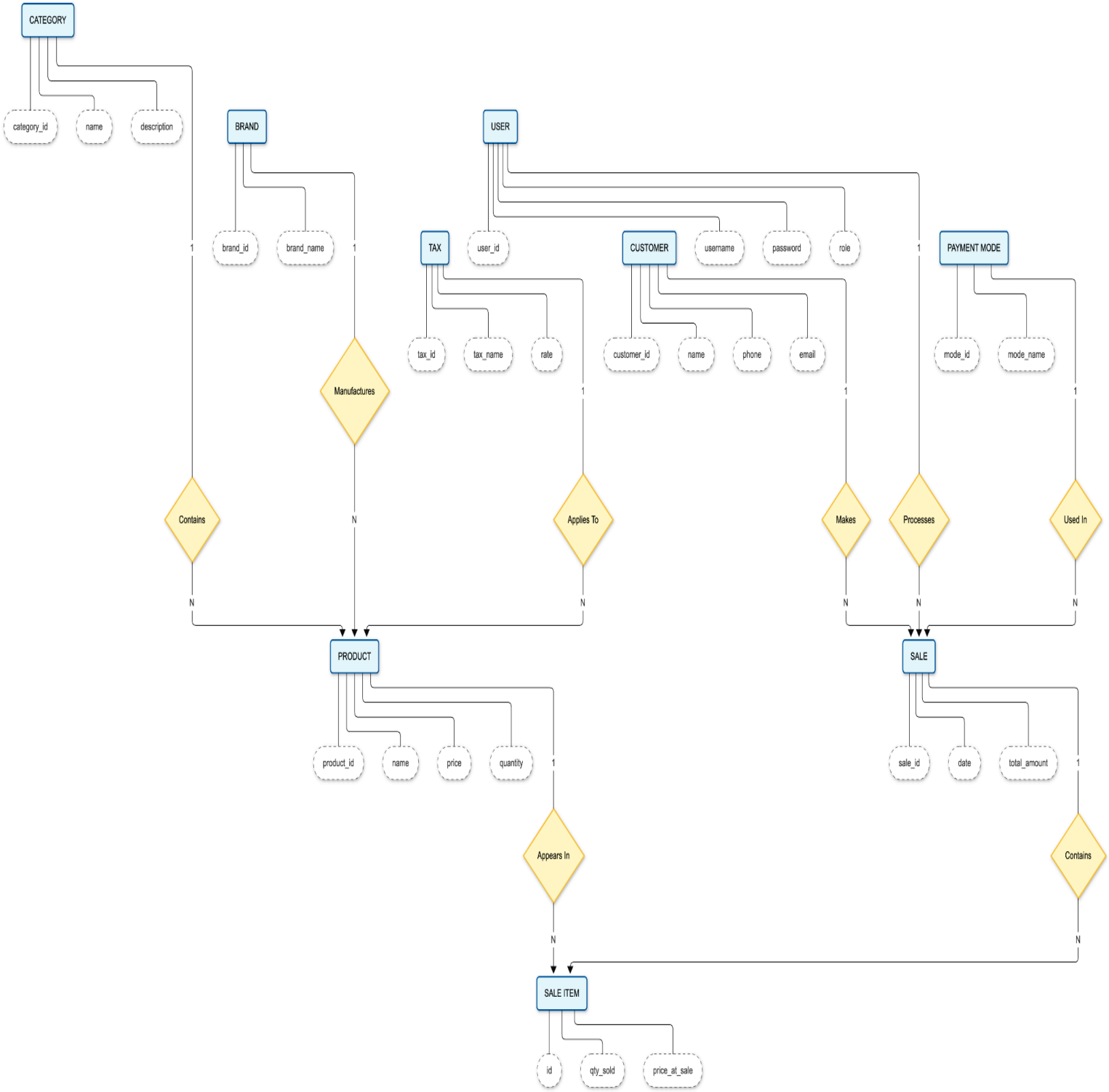
- User —-> Sale
    - Relationship: One User (Admin/Staff) *processes* many Sales.
    - Cardinality: 1 : N (One-to-Many)
    - Link: sales.user_id references users.user_id.
- Customer —-> Sale
    - Relationship: One Customer *makes* many Sales (Purchases).
    - Cardinality: 1 : N (One-to-Many)
    - Link: sales.customer_id references customers.customer_id.
- Payment_Mode —-> Sale
    - Relationship: One Payment Mode (e.g., UPI) *is used in* many Sales.
    - Cardinality: 1 : N (One-to-Many)
    - Link: sales.mode_id references payment_modes.mode_id.

3. Transaction Detail Relationships (The Items)

This is the bridge between the Bill and the Inventory.

- Sale —-> Sale_Item
    - Relationship: One Sale (Invoice) *contains* many Sale Items (Rows in the bill).
    - Cardinality: 1 : N (One-to-Many)
    - Link: sale_items.sale_id references sales.sale_id.
- Product —-> Sale_Item
    - Relationship: One Product *appears in* many Sale Items (Across different bills).
    - Cardinality: 1 : N (One-to-Many)

- Link: sale_items.product_id references products.product_id.

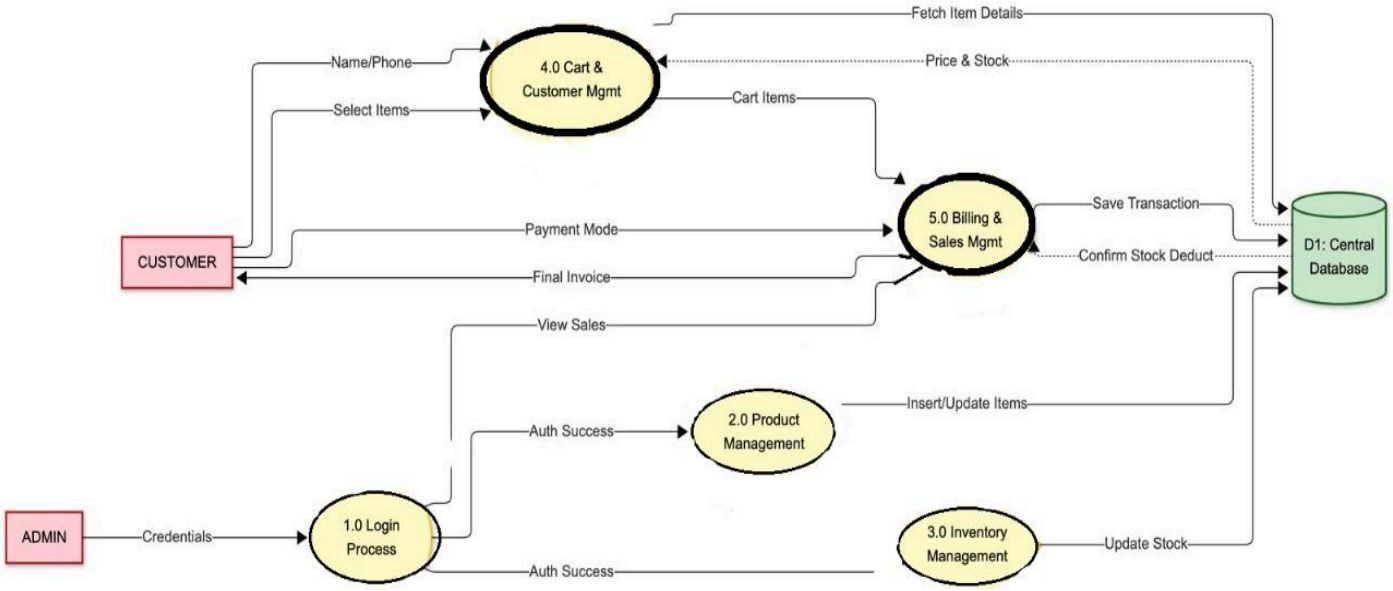


Data Flow Diagram (DFD) :

1. **Input:** Admin inputs Master Data; Customer inputs Order.
2. **Process:** System checks Stock -> Fetches Tax from DB -> Calculates Total.
3. **Storage:** Transaction saved to `sales`/`sale_items`; Stock deducted in `products`.

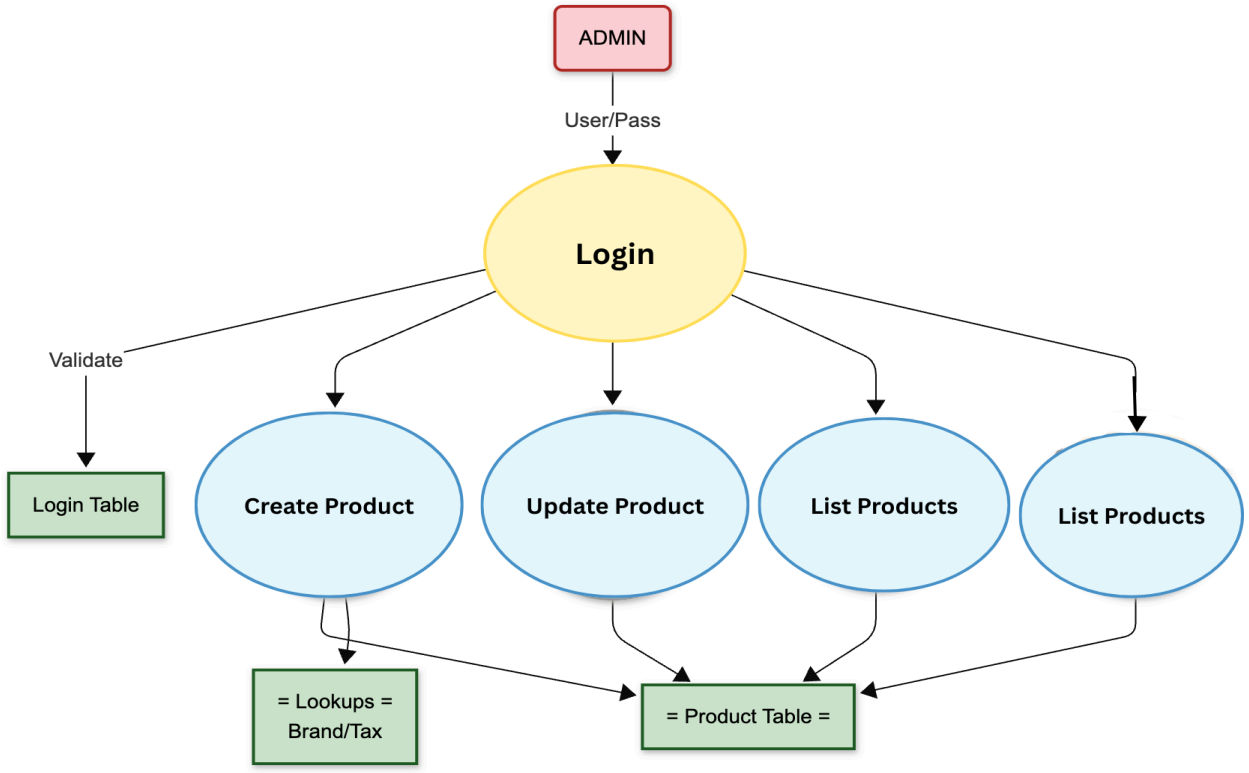
Data Flow Diagram **Level 0**:

Data Flow Diagram **Level 1**:

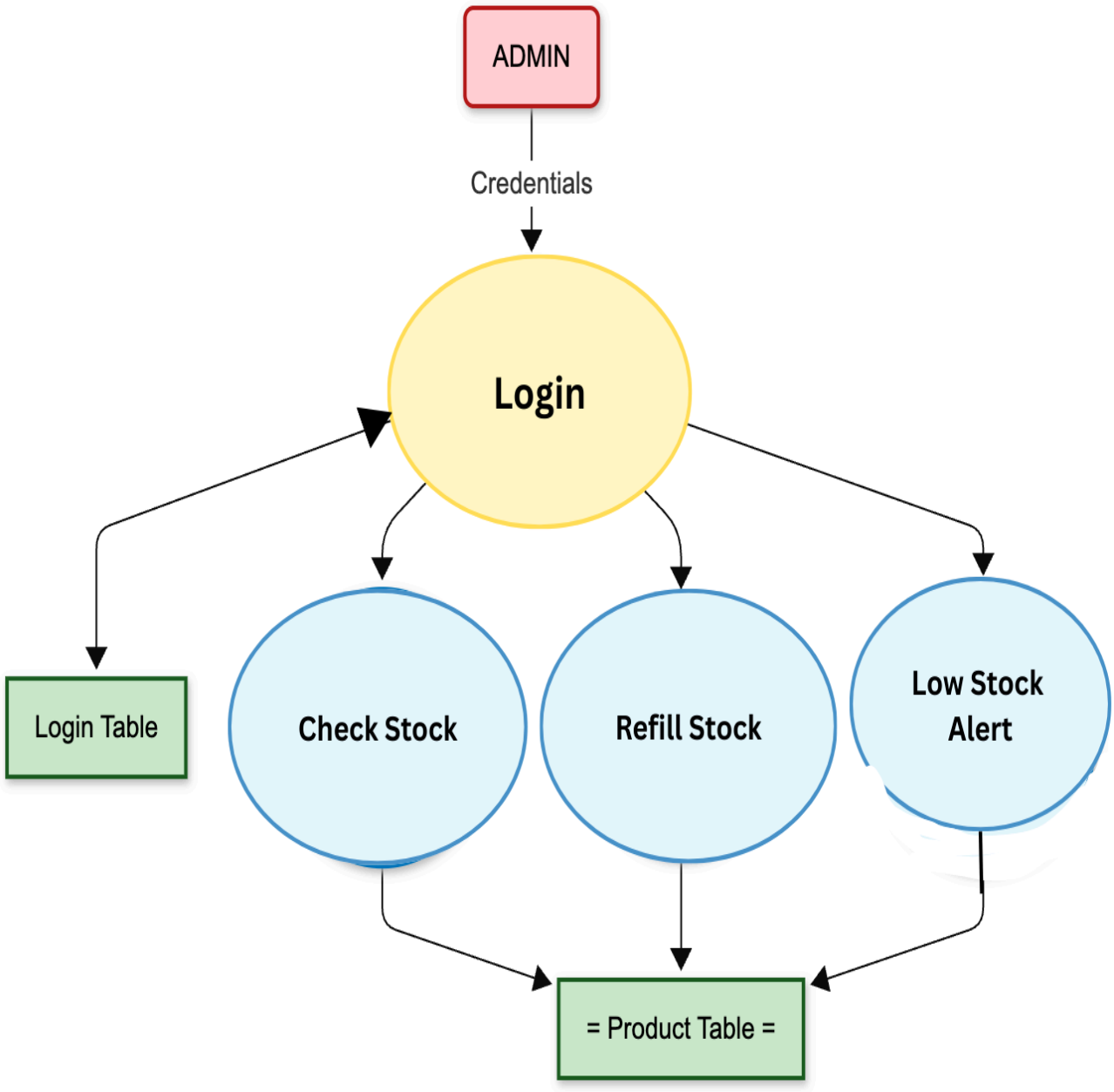


Data Flow Diagram **Level 2:**

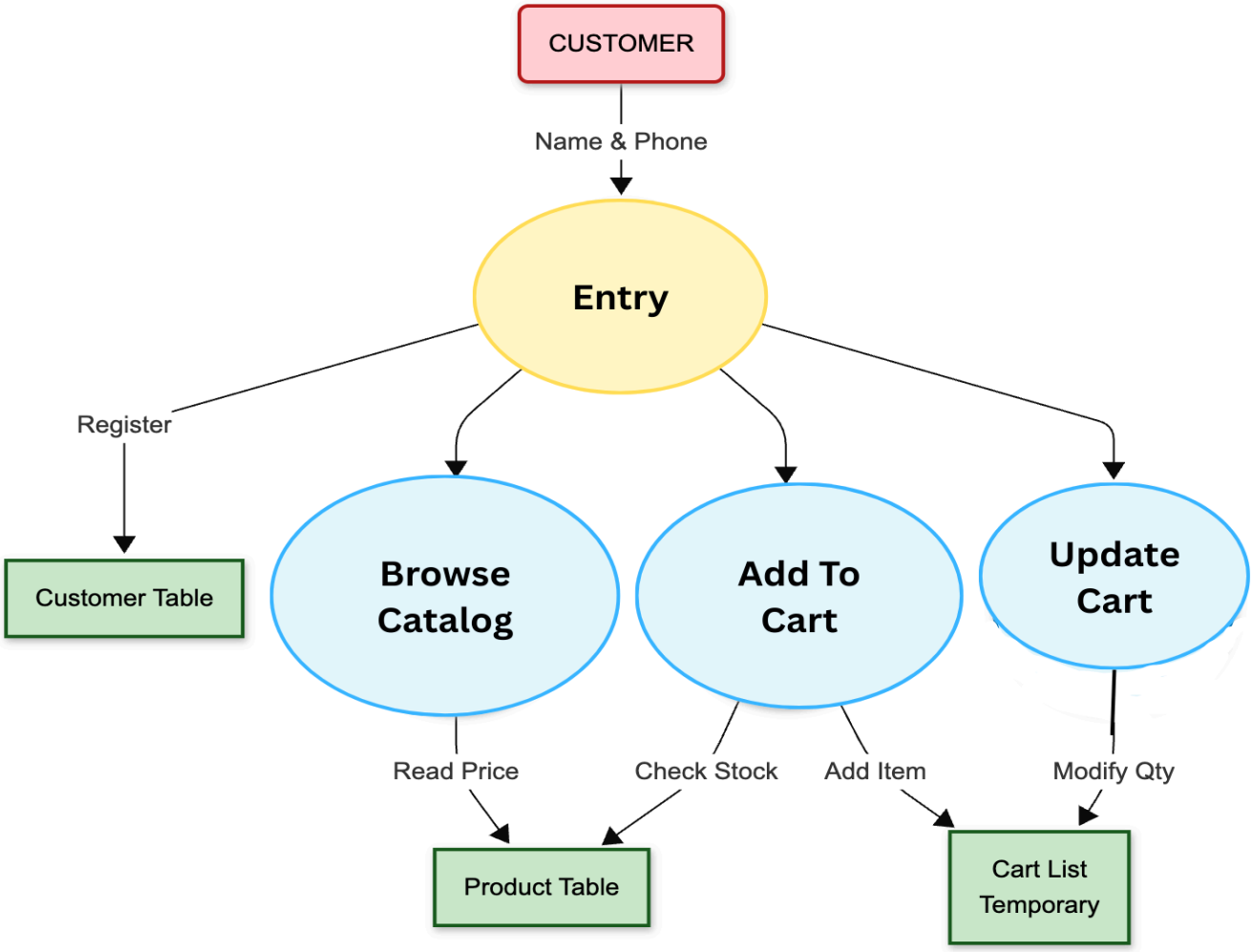
Module 1: Product Management (Admin)



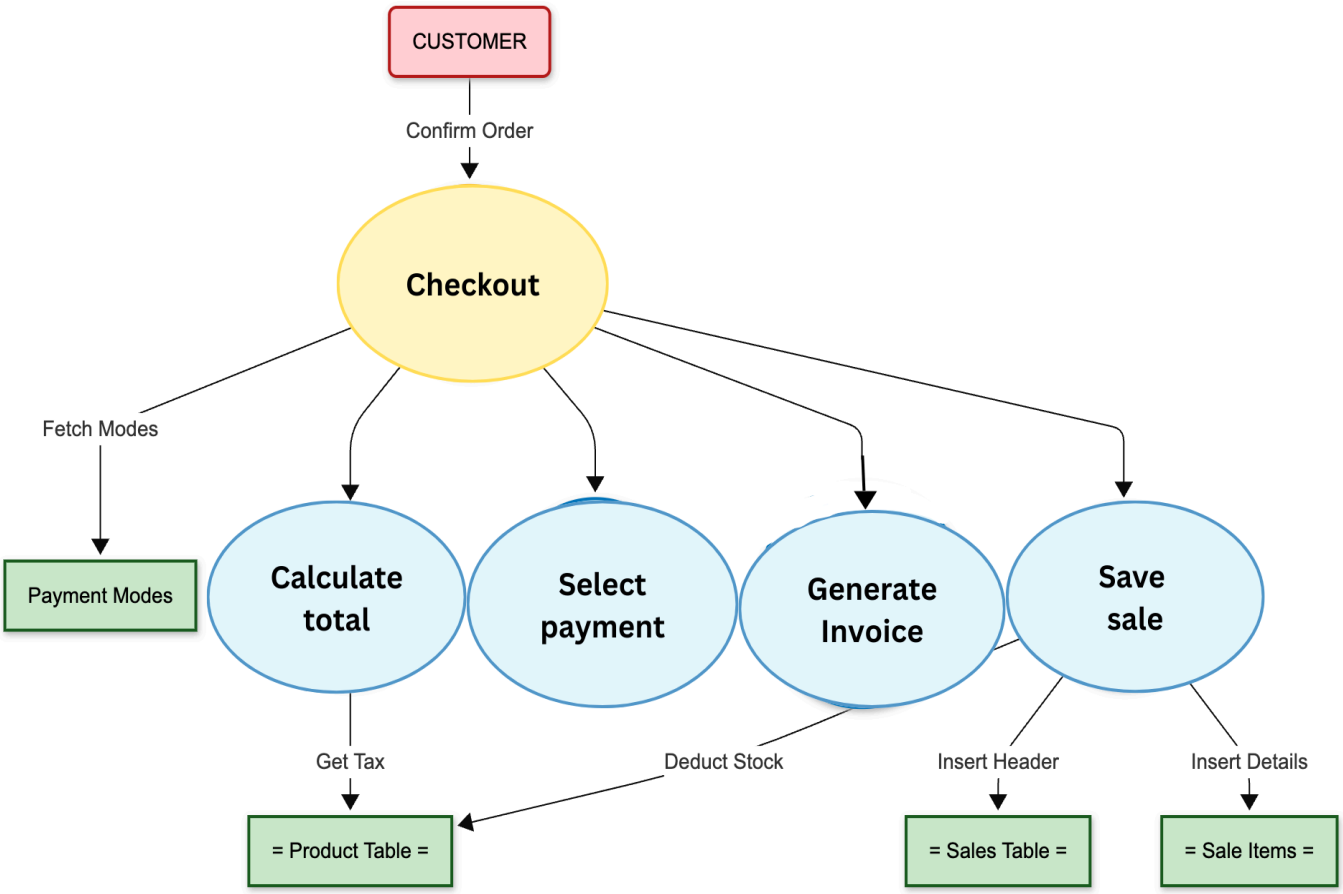
Module 2: Inventory Management (Admin)



Module 3: Cart & Customer Management (Customer)



Module 4: Billing & Sales Management (Sales)


CUSTOMER
Confirm Order
Checkout
Fetch Modes
Payment Modes
Calculate total
Select payment
Generate Invoice
Save sale
Get Tax
Deduct Stock
Insert Header
Insert Details
= Product Table =
= Sales Table =
= Sale Items =

Complete Structure

This design pattern ensures a clean separation of concerns, where the data (Model), database logic (DAO), and user interaction (Controller) are kept independent. This structure makes the application easy to debug, test, and scale.

The project is divided into four primary packages/layers:

1. Model Layer

Each class acts as a digital mirror of a specific database table. These classes use `private` variables for data security (Encapsulation) and `public` Getter/Setter methods for access.

- Entities:
  - `User`: Represents Admin/Staff credentials and roles.
  - `Product`: Represents inventory items with Price, Quantity, and Foreign Keys.
  - `Customer`: Represents buyer details (Loyalty data).
  - `Sale`: Represents the Bill Header (Date, Total, Payment Mode).
  - `SaleItem`: Represents individual line items inside a bill.
  - `Category`, `Brand`, `Tax`, `PaymentMode`: Represent the lookup data configuration.
- Purpose:
  - Ensures type safety within the Java application.
  - Facilitates the easy transfer of data between the Database and the UI.

2. DAO Layer

The DAO (Data Access Object) layer handles all direct communication with the MySQL database. It abstracts the SQL logic from the rest of the application.

- Primary DAO Classes:
  - `UserDAO`: Handles Login authentication logic.
  - `ProductDAO`: Manages CRUD operations for Inventory (Add, Update Stock, Delete).
  - `SalesDAO`: The most complex class; it handles the Atomic Transaction of generating a bill, saving items, and deducting stock simultaneously.
  - `MasterDAO`: Fetches dropdown lists for Categories, Brands, and Taxes.
  - `CustomerDAO`: Checks if a customer exists and registers new ones automatically.
- Responsibilities:
  - Executing `SELECT`, `INSERT`, `UPDATE` queries using JDBC PreparedStatements.
  - Managing SQL Exceptions.
  - Handling Database Transactions (Commit/Rollback).

3. Utility Layer

This layer contains infrastructure helper classes used system-wide to maintain connectivity.

- Core Class: `DataBaseUtil.java`

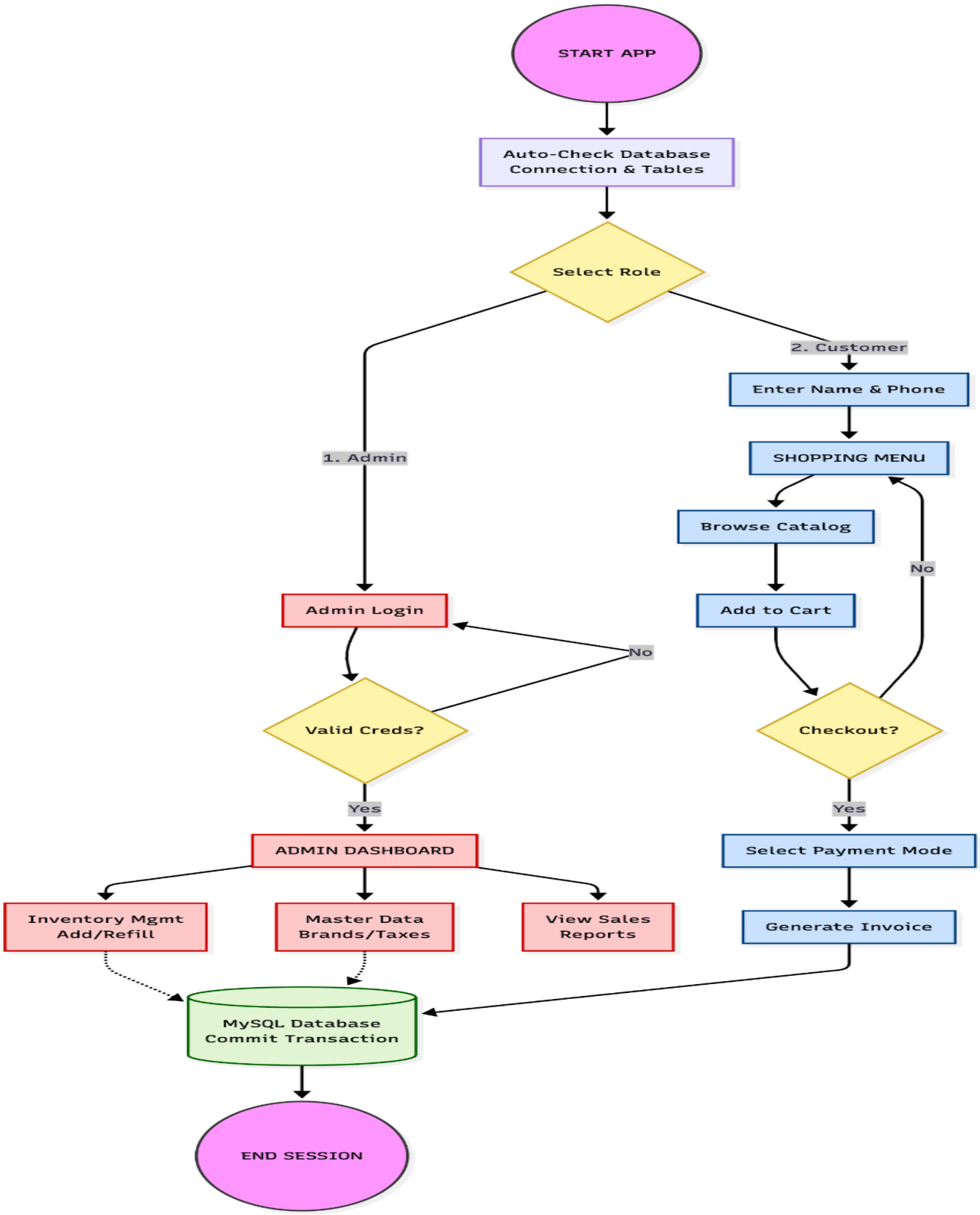
- Key Functions:
    - Connection Management: Loads the JDBC Driver and establishes a connection to MySQL.
    - Lazy Initialization: A unique feature of this project. On the very first run, it checks if the 9 tables exist. If not, it automatically creates the database structure and inserts default admin credentials. This makes the software "Plug-and-Play."

4. Controller Layer

The Main class serves as the entry point and the "Brain" of the application.

- Class: `App.java`
- Responsibilities:
    - UI/UX Flow: Displays the interactive Console Menu.
    - Input Handling: Uses the `Scanner` class to capture user choices.
    - Routing: Directs the user to the Admin Dashboard (if logged in as Admin) or the Customer Shopping Interface.
    - Business Logic: Validates inputs (e.g., ensuring a user cannot buy more quantity than available in stock) before calling the DAO layer.

Process Logical Diagram



Platform Used

Hardware Requirement

- **Processor:** Intel Core i3 or higher.
- **RAM:** 4 GB minimum.
- **Storage:** 500 MB free space.

Software Requirement

- **Operating System:** Windows 10/11, MacOS, or Linux.
- **Programming Language:** Java SE (JDK 1.8 or higher).
- **Build Tool:** Apache Maven 3.x.
- **IDE:** Eclipse IDE (Enterprise Java Developers edition).
- **Database:** MySQL Server 8.0.
- **Dependencies:** `mysql-connector-j` (Managed via `pom.xml`).

Future Scope

The current version is a fully functional CLI application. However, it provides a foundation for:

1. **Web-Based Frontend:** Migrating the Logic to a **Spring Boot** backend with a React JS frontend.
2. **Barcode Integration:** Adding a physical scanner to read Product IDs automatically.
3. **Payment Gateway:** Replacing simulated payments with real UPI/Stripe integration.
4. **Graphical Dashboard:** Adding charts for "Top Selling Products" using JavaFX.

Bibliography

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- **Database:** MySQL Normalization principles.
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- **JDBC MySQL Connector :-** https://dev.mysql.com/downloads/connector/j
- **GeeksforGeeks** – Java & JDBC tutorials
- MySQL Official Documentation (Foreign Keys & Normalization).